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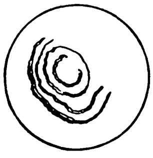
Ferns and their Development.

By John Kruttschnitt, New Orleans, La.

In transverse sections of the stipes of ferns the vascular bundles form regular patterns, different in each tribe and genus. By comparison of sections of a large number of ferns, it appears to me that in cases where difficulties are met with in classifying, the examination of transverse sections might overcome them. Such difficulties exist in Nephrodieæ and Aspidieæ. The section of a Nephrodium is entirely different from a section of an Aspidium; there remains no room to doubt to which genus they respectively belong. Such examination does not require delicate manipulation; a look at the cut end of the frond is sufficient. With other genera the thing is not so simple; it will become necessary to resort to the microscope for assistance. Slight modifications exist also in the sections of the various species of a genus.



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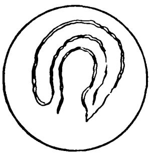

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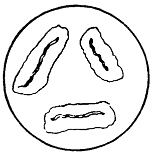

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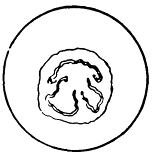

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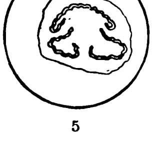

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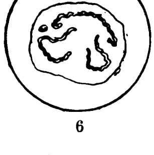

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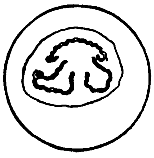
A section of a bud cut from the rhizome of a tree-fern, a *Cibotium*, shows at first a ring composed of several layers of parenchymatic and sterenchymatic tissues; sections nearer the apex show the ring open, and by degrees it is divided in three different sections, assuming the arrangement as seen in the diagrams, figs. 1, 2 and 3. The caudex itself shows a similar structure, but of course on a much larger scale.

The development of the pinna from the stipe forms a very interesting study. Sections of the stipe of a *Cibotium regale* show the vascular bundles arranged in the form of an arc of a circle, with loops at the concave side of the ends; below the arc, but detached from it, are two open loops, roughly pear-shaped (Fig. 4). A section higher up shows the little loop at one end of the arc lengthened out (Fig. 5). Successive sections show the loop closed into a ring (Fig. 6) which gradually detaches itself and connects with one of the pear-shaped loops on its side (Fig. 7). Figure 8 shows the effect on the pear-shaped loop of the absorption of the little ring. It will be seen that it lengthens out on the side where the connection took place and, that this part gradually becomes detached from the body of the loop; complete separation being shown in figure 9, where the pinna is about to leave the stipe and figure 10 is a section of the pinna.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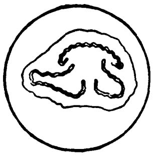
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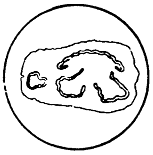
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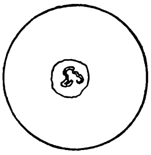
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The same process is now carried on on the other side of the stipe or rachis, alternating from right to left. A similar process obtains also in all the ferns I have examined. The pinnæ are formed by a portion of the vascular bundles becoming detached from the rachis, evidently by an ascending spiral motion, by which the cellular tissue is forced between the vascular fibres and a centrifugal tendency is thus imparted to the tissues.